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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification 6 :</b> <b>H04Q 7/38</b>	<b>A2</b>	<b>(11) International Publication Number:</b> <b>WO 99/11087</b> <b>(43) International Publication Date:</b> 4 March 1999 (04.03.99)
<b>(21) International Application Number:</b> PCT/NL98/00480 <b>(22) International Filing Date:</b> 26 August 1998 (26.08.98) <b>(30) Priority Data:</b> 1006862 27 August 1997 (27.08.97) NL <b>(71) Applicant (for all designated States except US):</b> LIBERTEL B.V. [NL/NL]; Avenue Cermique 300, NL-6221 KX Maastricht (NL). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> OP DEN CAMP, Rudi, Hubertus, Carolus, Margaretha [NL/NL]; Maastrichterbaan 10, NL-6163 MA Geleen (NL). BOS, Willem [NL/NL]; Maastrichterbaan 18, NL-6163 MA Geleen (NL). <b>(74) Agent:</b> SMULDERS, Th., A., H., J.; Vereenigde Octrooibureaux, Nieuwe Parklaan 97, NL-2587 BN The Hague (NL).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>In English translation (filed in Dutch). Without international search report and to be republished upon receipt of that report.</i>
<b>(54) Title:</b> METHOD AND SYSTEM FOR PROCESSING CALLS FOR COMMUNICATION EQUIPMENT WITH A SUBSCRIBER NUMBER PORTED FROM A FIRST OPERATOR TO A SECOND OPERATOR, IN PARTICULAR SUITABLE FOR USE IN SYSTEMS FOR MOBILE COMMUNICATION  <b>(57) Abstract</b> <p>A method for processing calls for communication equipment with a subscriber number ported from a first communication network of a first operator to a second communication network of a second operator, wherein in each communication network a database of ported numbers is formed, which is accessible from at least one gateway exchange, and in which the subscriber numbers ported from one operator to another operator are stored together with information about the network to which the subscriber numbers belong, and upon an incoming call at the network for a particular subscriber number, the called subscriber number is compared with the subscriber numbers in the database and on the basis of the result of that comparison routing information for the further processing of the call is composed.</p>		

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Title: Method and system for processing calls for communication equipment with a subscriber number ported from a first operator to a second operator, in particular suitable for use in systems for mobile communication.

This invention relates to a method for processing calls for communication equipment with a subscriber number ported from a first communication network of a first operator to a second communication network of a second operator. This invention further relates to a communication system suitable for practicing a method according to the invention.

If a telephone subscriber has a choice between more than one provider of telephone services, hereinafter called operator, there is also a possibility for the subscriber to switch from one operator to another. It would be objectionable for the subscriber if such a switch were to entail cancellation of the old subscriber number and assignment of a new subscriber number. The authorities, too, with a view to as much freedom of competition as possible, object to such a procedure, since it might inhibit the subscriber from switching operators.

Accordingly, there exists a need for a method which allows the subscriber to retain the original telephone number, even if he switches operators. In the fixed telephony network, it is relatively simple to create possibilities for retaining the number, because the subscriber apparatus is always at the same location and is always connected to the same telephone exchange. In mobile telephony networks, however, this is not the case. The subscriber, with his mobile telephone, may be in a great many locations removed far apart, and is difficult to trace if, for instance, he has a subscriber number that was originally provided by

another operator. In addition, obviously, the costs and proceeds of mobile telephone traffic should be ascribed to the correct operators.

5 The object of the invention is to provide for the need outlined and generally to provide a method which routes telephone calls efficiently from or to mobile telephones with a number transferred from one operator to another. Such a number will hereinafter be referred to as a 'ported' number.

10 According to the invention, a method of the above-described type is characterized in that in each communication network a database of ported numbers is formed, which is accessible from at least one gateway exchange, and in which the subscriber numbers ported  
15 from one operator to another operator are stored together with information about the network to which the subscriber numbers belong; that upon an incoming call at the network for a particular subscriber number, the called subscriber number is compared with the  
20 subscriber numbers in the database; and that on the basis of the result of that comparison, routing information for the further processing of the call is composed.

Hereinafter, the invention will be further  
25 described with reference to the accompanying drawings.

Fig. 1 schematically shows the problem to which the invention provides a solution;

Fig. 2 schematically illustrates how a mobile telephone call is normally routed to the correct  
30 subscriber number within a telephony network;

Fig. 3 schematically shows an example of a telephony network according to the invention, coupled to a similar, second network of another operator;

Fig. 4 schematically shows a variant, with a  
35 routing enquiry originating from a foreign exchange;

Fig. 5 schematically shows a second variant, with a routing enquiry originating from a foreign exchange and involving a switched subscriber;

Fig. 6 shows an example of a flow diagram of the operation of a special memory device for use in a method according to the invention; and

Fig. 7 shows a modification of Fig. 6.

Fig. 1 schematically illustrates the problem to which the invention provides a solution. A call transmitted by subscriber A from a fixed or mobile telephone apparatus, intended for mobile subscriber apparatus B, reaches telephone network I of a first operator via one of the existing paths for that purpose. The reason that the call reaches the network I is that subscriber A has dialled a mobile telephone number which, as appears from a particular characterizing part of the number, belongs to the number database of network I. Thus, for instance, a mobile telephone number starting with 06 53 belongs to the database of PTT Telecom, while 06 54 belongs to the Libertel database.

Accordingly, in the above-described situation, subscriber A, or anyone processing his call, expects that subscriber B is to be found in the network I. However, if subscriber B, while maintaining the original mobile telephone number, has switched to another operator, who manages network II, as indicated with an arrow 1, special measures are required to establish nonetheless a connection with subscriber B, even though that subscriber number B now belongs to the database of network II. The call coming in at network I must therefore be transmitted directly (arrow 2) or indirectly to network II. To that end, it should be possible to detect in network I that subscriber B no longer belongs to the database of network I and also to which other operator subscriber B has switched.

Fig. 2, for clarification, first illustrates how a connection with a mobile telephone apparatus is normally established. A call from subscriber A, intended for mobile subscriber B, comes in at a telephone exchange 5 (the gateway exchange, usually indicated by the abbreviation GMSC (Gateway Mobile Switching Centre)). It is assumed that subscriber B has a telephone number that is not a ported number and with which, accordingly, contact can in fact be established in the network to which the telephone exchange 5 belongs. However, it is not possible simply to establish direct contact with subscriber B on the basis of the number of subscriber B as selected by subscriber A, since subscriber B has a mobile apparatus and should therefore be traced first. To that end, the exchange 5 transmits a routing enquiry, that is, a request for route information, to a special location register 6, usually designated by the abbreviation HLR (= Home Location Register). The routing enquiry is indicated symbolically with an arrow RE (Routing Enquiry).

The location register contains information about the place where the called subscriber, at any rate his mobile telephone apparatus, is located. That information is available for all mobile telephones that have not been set out of service, in that each mobile telephone transmits a presence signal at predetermined intervals (18 minutes at present), which contains information about the identity of the apparatus, or the subscriber, and is received by a receiver belonging to the network. Since the location of all receivers is known, it is also known in what area the telephone is located and via which exchange subscriber B can be reached. This information is transmitted to the location register. Obviously, it is possible that the telephone is located entirely outside the reach of the

network. In that case, (temporarily) no contact with the telephone is possible.

The location register accordingly contains information about the location of the called telephone in the form of the address of the host exchange 7 which, at that time, operates the mobile telephone of subscriber B to be traced. The location register asks the host exchange 7 for a temporary number ("roaming number" RN), and this number is passed on by the location register to the gateway exchange (GMSC) 5. The gateway exchange 5 finally routes the call to the subscriber apparatus B in the normal manner.

Fig. 3 schematically illustrates an example of a manner in which, according to the invention, a connection can be established with a mobile telephone apparatus with a ported number.

A call, indicated by arrow 10, intended for a mobile telephone, reaches, directly or indirectly, a gateway exchange (GMSC) for mobile telephony 11 of, for instance, GSM network I. Then a routing enquiry signal is composed and sent to a special memory device 12 via connection 13. The memory device 12, also referred to as signalling relay or N(umber) P(ortability) signalling relay, contains information about all ported numbers, whether ported in or ported out, and the associated operators and networks, respectively. As address for the routing enquiry signal, the number of the mobile telephone being traced can be advantageously used. If the target number is a number of the network I itself or a ported-in number, the memory device 12 sends a signal back via connection 14. This signal contains information about a location register. Usually, a network for mobile telephony contains more than one location register, but each location register contains information about specific series of numbers. The memory device 12 knows what location register

contains information about a particular mobile telephone number. In the example shown, two location registers HLR1 and HLR2 are represented. Each location register has a specific address number and the memory device 12 adds this number to the routing enquiry signal, so that the exchange 11 can send this signal to the correct location register via connection 15. The location register, HLR1 or HLR2 in this example, then proceeds to compose a temporary number ("roaming number"), which corresponds with the mobile apparatus being searched for. The temporary number contains inter alia the number ("global title" or "point code") of the host exchange and is transmitted via connection 16 to the gateway exchange 11, which provides for a connection 17 with the host exchange 18. The host exchange 18, finally, can establish the connection with the target apparatus.

In the case where the called subscriber is operated by another network of another operator, the memory device 12 itself forms a temporary number, which may consist, for instance, of the mobile ISDN number of the called subscriber, preceded by a so-called prefix, which indicates by which network the called subscriber is operated. The temporary number thus formed is returned via connection 14 to the gateway exchange 11. The exchange 11 recognizes the prefix and transmits the temporary number to the associated network II via an internetwork connection 20. Similarly, the exchange 11 can receive signals via the internetwork connection 21 from network II, which is built up similarly to network I. Corresponding parts of network II are indicated by the same numerals as in network I, but primed.

Depending on the arrangements made, the prefix can or cannot be ported to the other network. Then, in network II, in a similar manner to that described hereinabove, using a memory device 12' and a location



register HLR', a connection with the relevant host exchange 18' and subsequently with the called mobile telephone can be established.

In the practice of the method described, number  
5 portability (transfer of subscriber numbers from one operator to the other) can be realized in a simple manner. Additional connections between the different networks are not needed. Obviously, every participating network does need to have the special memory device 12  
10 or 12', which can indicate either the relevant location register or the relevant other network.

It is noted that a similar method is applicable in facsimile and data transmission. Further, a method according to the invention is applicable for routing  
15 enquiries originating from another network (SOR - Support of Optimal Routing) and for so-called SMS (Short Message Service) messages.

If a routing enquiry is received from an exchange of another network, for instance a foreign network, the  
20 exchange 11 can forward the routing information obtained in the manner described above to the foreign exchange, which can then proceed to establish the connection with the target subscriber in the most optimal manner. An example is shown schematically in  
25 Fig. 4. An exchange 30 in a foreign country F transmits via link 31 an enquiry for routing information to an exchange 11 in the home country H. The exchange 11 obtains the requested information via the special memory device 12 and a location register HLR, and  
30 transmits the information via link 31 back to the exchange 30. Exchange 30 then proceeds to establish, directly or indirectly, the connection between subscriber A and the target subscriber B.

Fig. 5 schematically shows an example of a variant  
35 in which a foreign exchange 30 asks an exchange 11 of network I in the home country H for routing

information. A search in the special memory device 12 shows that the target subscriber has switched to network II in the home country H. Exchange 11 therefore forwards the enquiry for routing information to exchange 11' of network II, which, via the special memory device 12' and the location register HLR', composes the requested information and proceeds to forward same via a direct connection 32 to the enquiring exchange 30 abroad.

10 It is noted that, technically speaking, it is not relevant whether the exchanges 30 and 11 are located in different countries or not, or whether the exchanges 11 and 11' are located in the same country or not.

Obviously, the exchange 11' could also send the requested routing information to the foreign exchange 15 30 via the exchange 11 of network I.

In a similar manner to that described above, so-called SMS (=Short Message Service) messages can be transmitted. In that event, the gateway exchange, in the case where the target subscriber is a subscriber 20 belonging to the exchange's own network (whether or not ported in), can forward the SMS signal, either directly or via the enquiring exchange, to the exchange operating the target subscriber.

25 If a switched (ported-out) subscriber is involved, it is also possible, after the correct HLR has been found in the second network, to forward the requested information via the gateway exchange of the first network, directly or via the enquiring exchange, 30 whether foreign or not, to the exchange operating the target subscriber. Also, alternatively, the gateway exchange of the second network could send the requested information to the enquiring exchange, or directly to the exchange operating the subscriber.

35 For the sake of completeness, Fig. 6 shows, in the form of a flow diagram, an example of the operation of

the special memory device 12. Upon entry of a call signal, it is first assessed in step 40 whether the address number (the "global title") contains the prefix of the network itself. If so, the global title is replaced by a number indicating the relevant HLR (step 41). If not, it is assessed in step 42 whether the MSISDN number (Mobile Subscriber ISDN) contained in the received title belongs to a subscriber of the network itself. If so, a number is formed with the address of the relevant HLR (step 43). If not, it is assessed in step 44 whether the calling subscriber is operated by the network itself. If not, the prefix of the operating network is added to the MSISDN number (step 45). If so, it is assessed in step 46 whether the received message is a routing information enquiry. If so, in step 47, the MSISDN number provided with a prefix is formed as a temporary number and transmitted. If not, the process continues with step 45.

Fig. 7 shows a flow diagram which is similar to Fig. 6, but utilizes a blocking of SMS messages not originating from a subscriber of the network itself. To that end, in this example, in step 50, it is first determined whether the received message is an SMS message intended for the SMS exchange of the network itself. If so, it is determined in step 51 whether the calling MSISDN number is a number of a subscriber of the network itself. If not, the message is refused (step 52), because this subscriber is not entitled to use the "short message service" of this network. This is reported to the calling number. If so, the message is provided with the address of the operating SMS exchange (step 53).

With the above-described method, a call for a mobile subscriber can be processed independently of whether or not the mobile subscriber is a subscriber of the network itself, or is a ported-in or ported-out

subscriber having a ported number. Also, with this method, it is no longer necessary to have a certain coupling between, for instance, the telephone, facsimile and data traffic numbers of a subscriber, as  
5 was often the case heretofore. Even if the subscriber were to switch his telephone number from a first operator to a second operator, and switch his fax number to a third operator, this would not pose any problem.

10 It is noted further that calls from mobile apparatus to fixed destinations with or without ported numbers can also be correctly routed with the method and the special memory device according to the invention.

Claims

1. A method for processing calls for communication equipment with a subscriber number ported from a first communication network of a first operator to a second communication network of a second operator,  
5 characterized in that in each communication network a database of ported numbers is formed, which is accessible from at least one gateway exchange, and in which the subscriber numbers ported from one operator to another operator are stored together with  
10 information about the network to which the subscriber numbers belong; that upon an incoming call at the network for a particular subscriber number, the called subscriber number is compared with the subscriber numbers in the database and on the basis of the result  
15 of that comparison, routing information for the further processing of the call is composed.
2. A method according to claim 1 for use in a network for mobile communication, which contains at least one location register, characterized in that the routing  
20 information contains the address of the relevant location register if the called subscriber number belongs to the network itself, and that the routing information contains the address of another network if the called subscriber number belongs to another  
25 network.
3. A method according to claim 2, characterized in that the routing information is forwarded via the gateway exchange to the relevant location register or to the other network.
- 30 4. A method according to claim 2 or 3, characterized in that the relevant location register completes the routing information and that a temporary subscriber number is assigned to the call, which is transmitted

via the gateway exchange to an exchange in the area where the mobile equipment is located.

5. A method according to any one of the preceding claims 2-4, characterized in that the routing information which is provided with the address of another network is transmitted to the other network in question, and in the other network, after comparison with the database of ported numbers, is completed and then transmitted back to the gateway exchange of the first network.
6. A method according to any one of claims 2-4, characterized in that the routing information provided with the address of another network is transmitted to the other network in question and in the other network, after comparison with the database of ported numbers, is completed and then transmitted directly to an operating network or an operating exchange.
7. A communication system comprising a communication network, a number of exchanges and communication equipment provided with subscriber numbers, characterized in that the communication network comprises at least one memory device, which is accessible from at least one gateway exchange and which contains a database of ported numbers, in which the subscriber numbers ported from one operator to another operator are stored together with information about the network to which the subscriber numbers belong, and that the gateway exchange is arranged to compare a called subscriber number with the database of ported numbers and, depending on the result of the comparison, to determine whether the call is intended for a subscriber number belonging to the network itself or another network.
8. A communication system according to claim 7, arranged for mobile communication and provided with at least one location register, characterized in that the

memory device is arranged, in the case of a subscriber number belonging to the network itself, to furnish to the gateway exchange the address of a location register relevant to the subscriber number.

- 5 9. A communication system according to claim 7 or 8, arranged for processing at least mobile telephone traffic and provided with a short message service (SMS), characterized in that the memory device is arranged to detect whether an SMS message originates
- 10 from a subscriber of the network itself or from a subscriber of another network.
- 10 10. A communication system according to claim 9, characterized by blocking means for blocking an SMS message originating from a subscriber belonging to
- 15 another network.

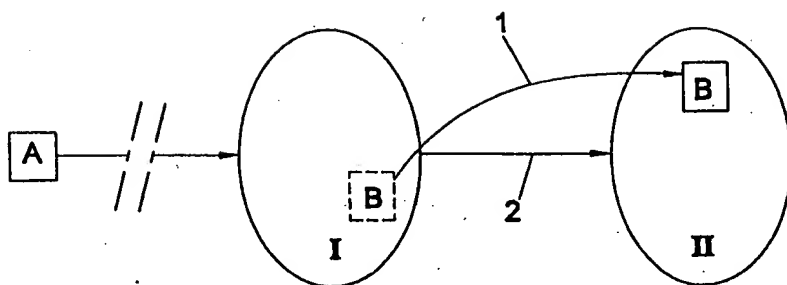


Fig. 1

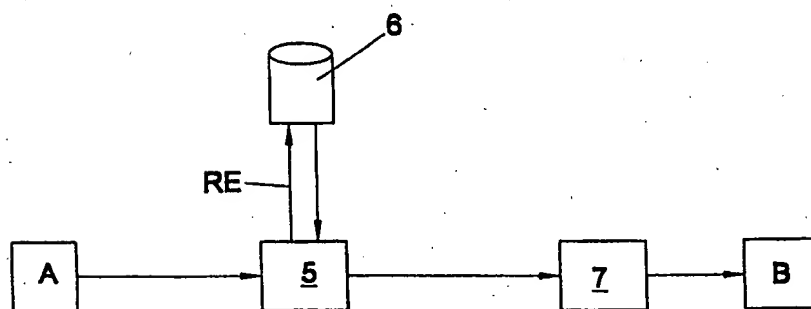


Fig. 2



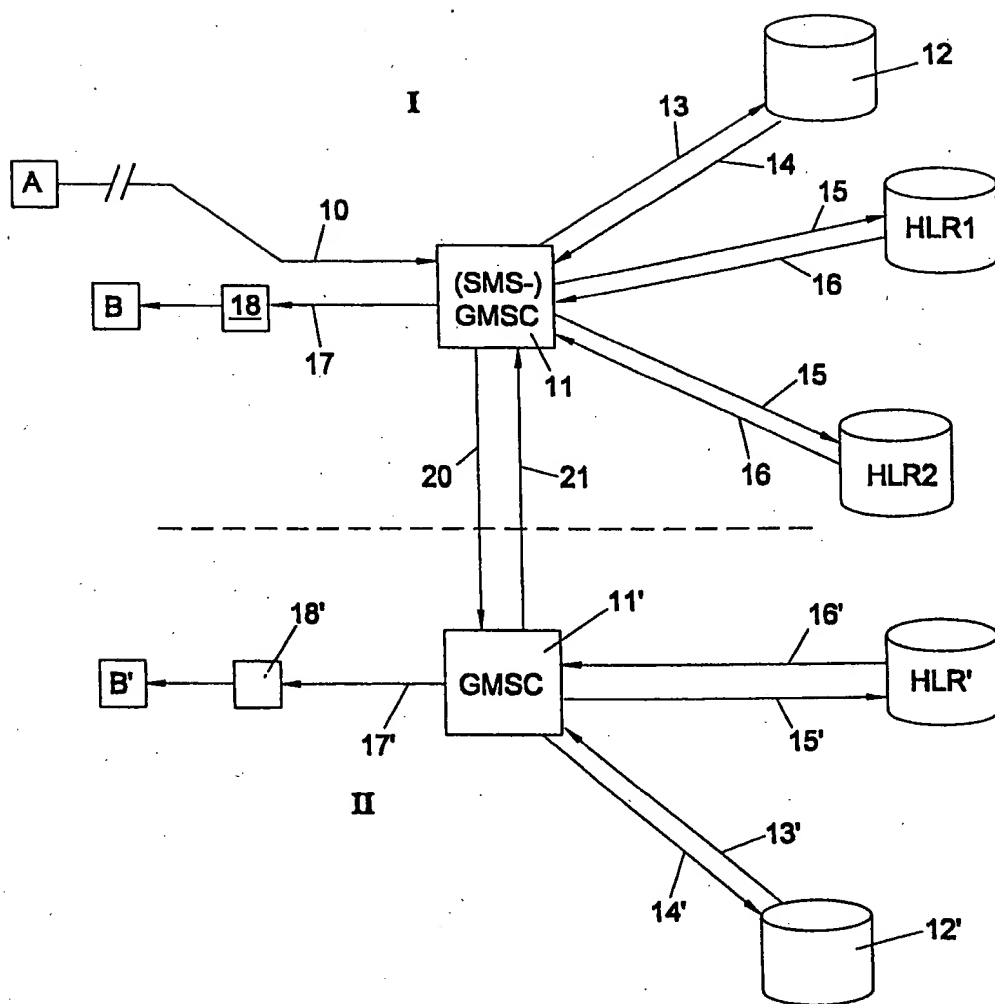


Fig. 3

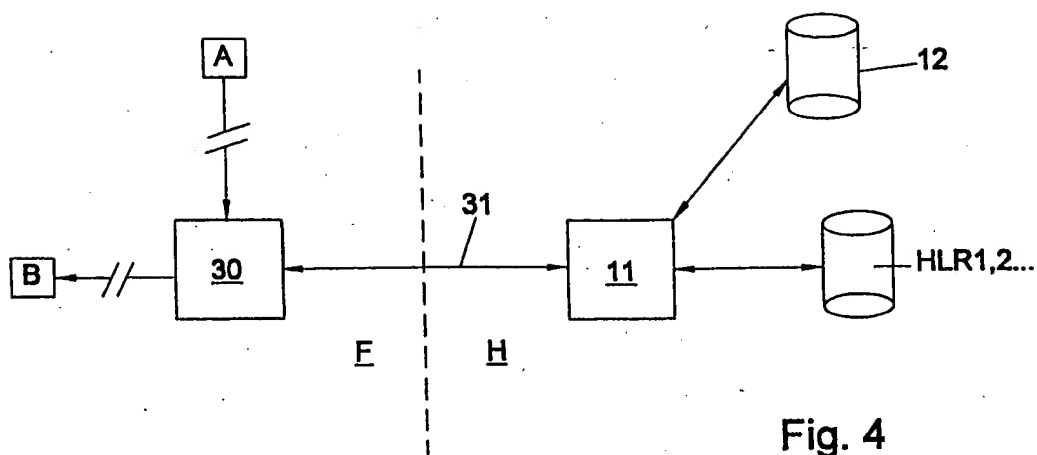


Fig. 4

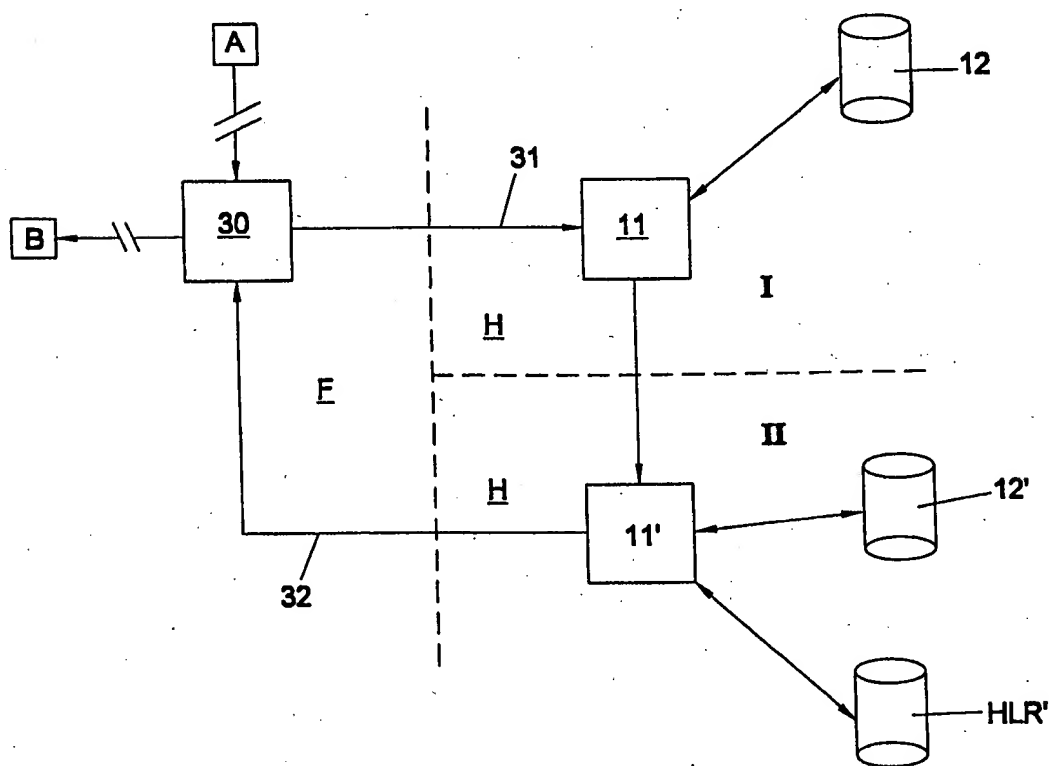


Fig. 5

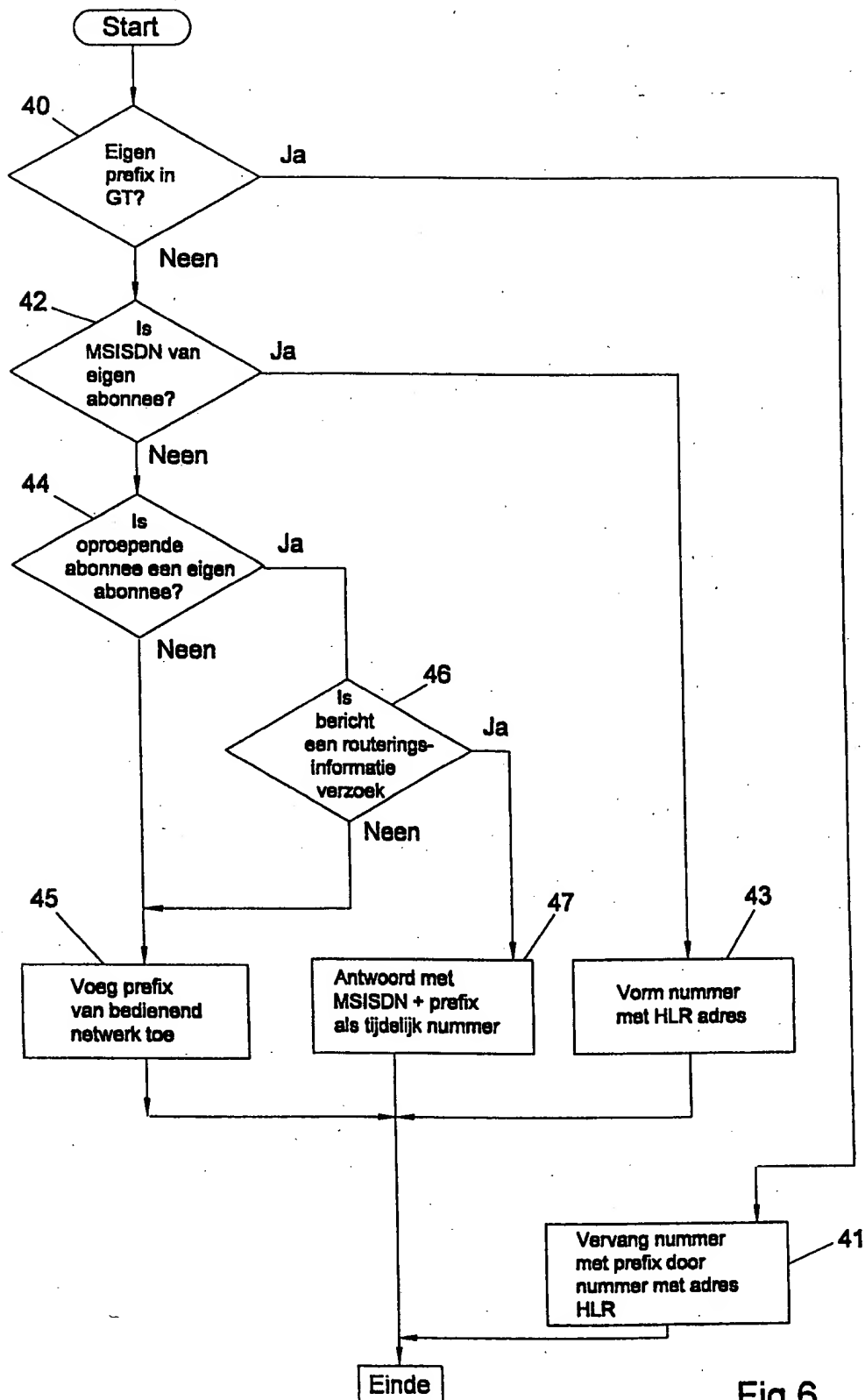


Fig.6

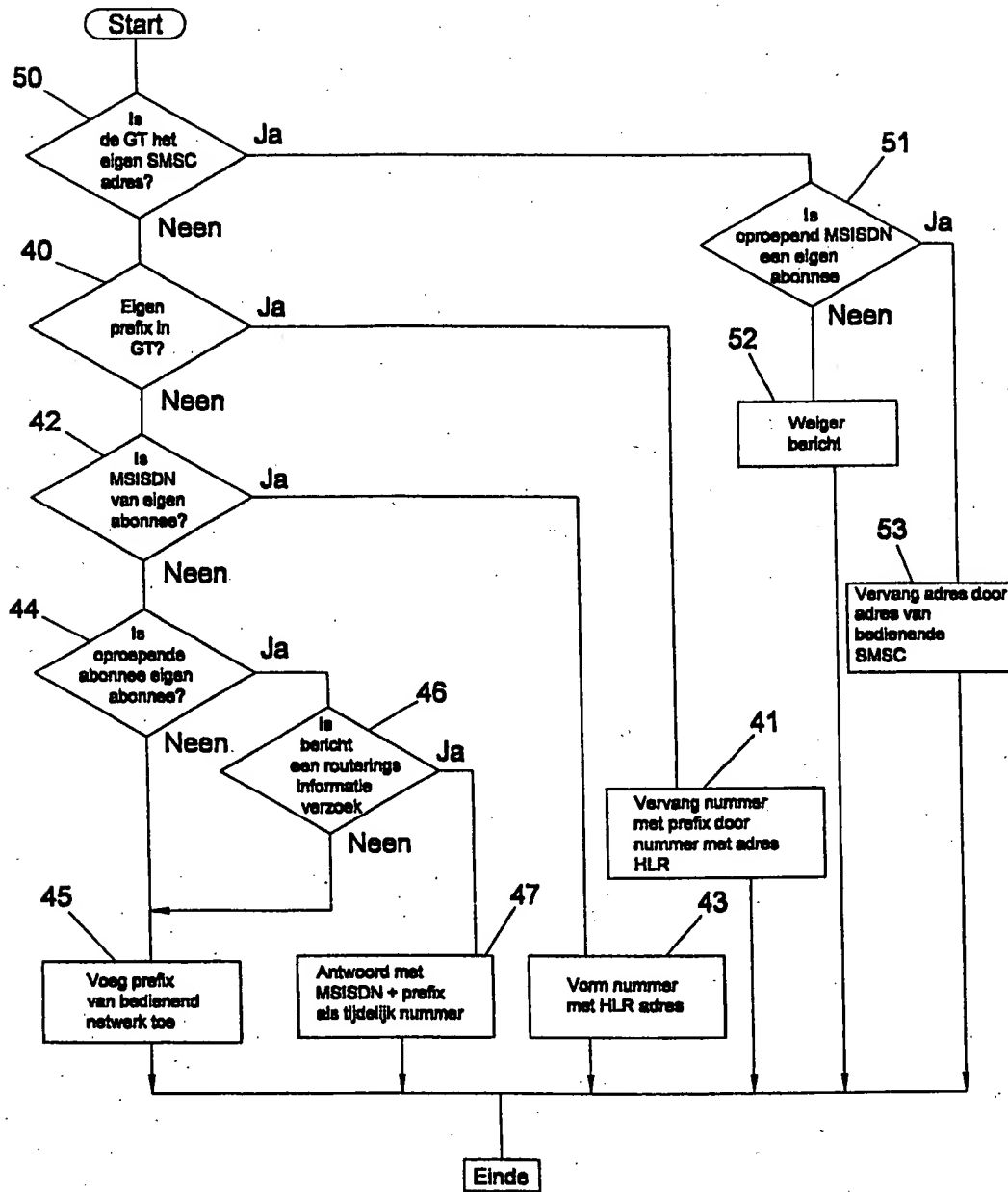


Fig. 7

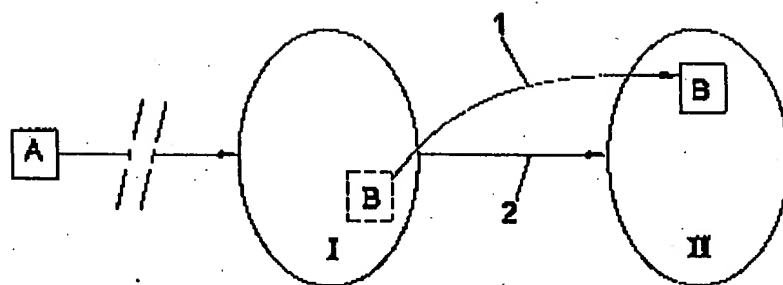


Fig. 1

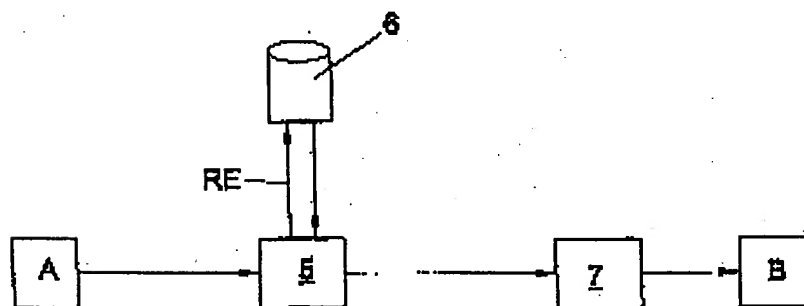


Fig. 2

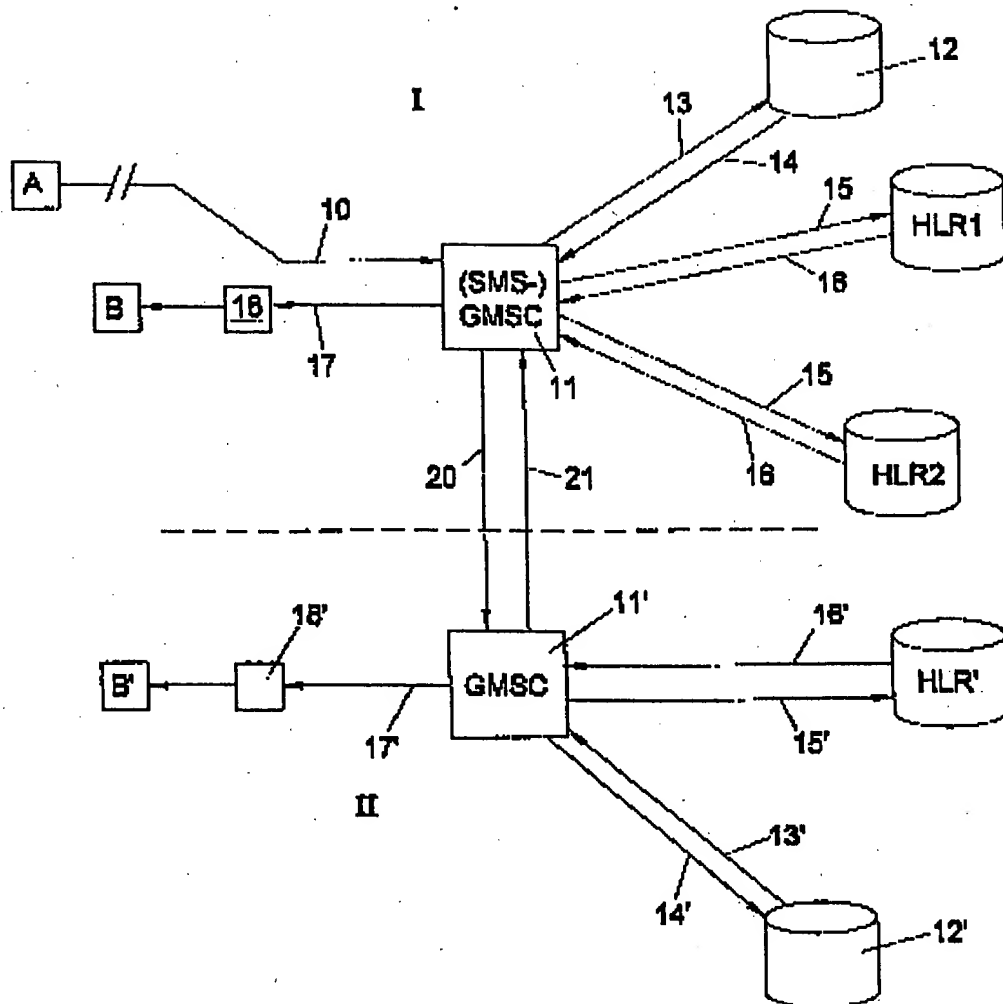


Fig. 3

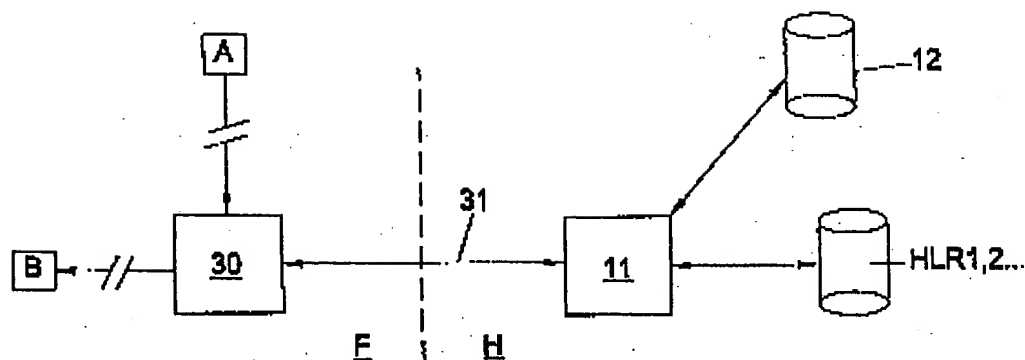


Fig. 4

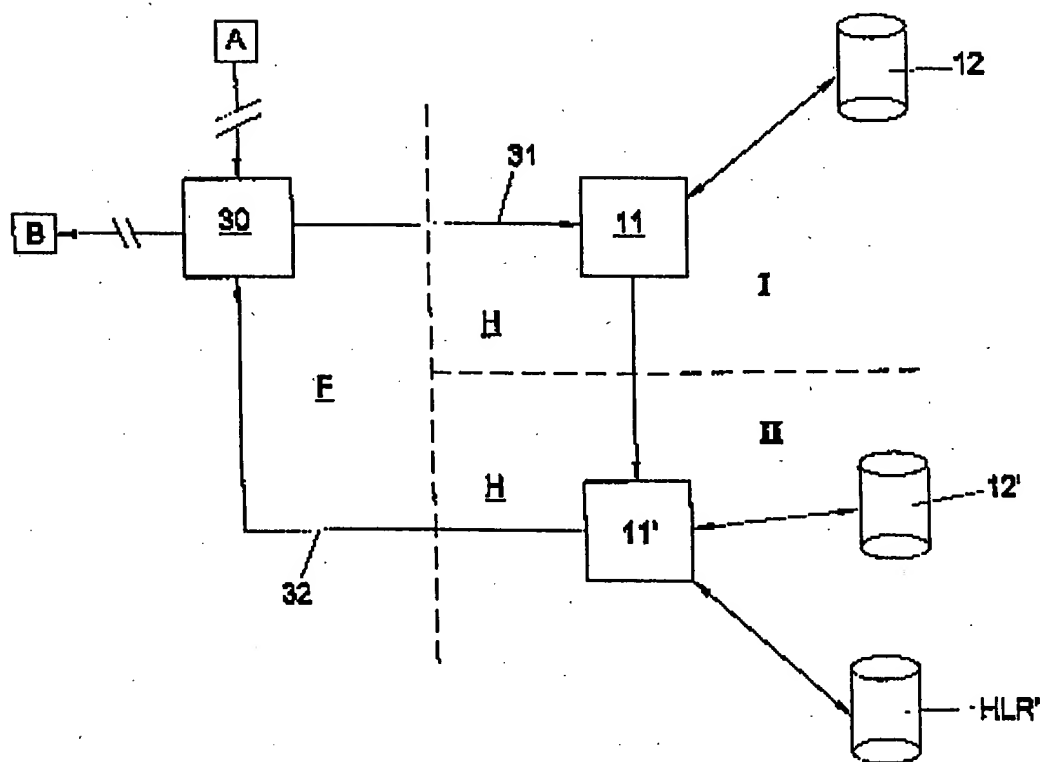


Fig. 5

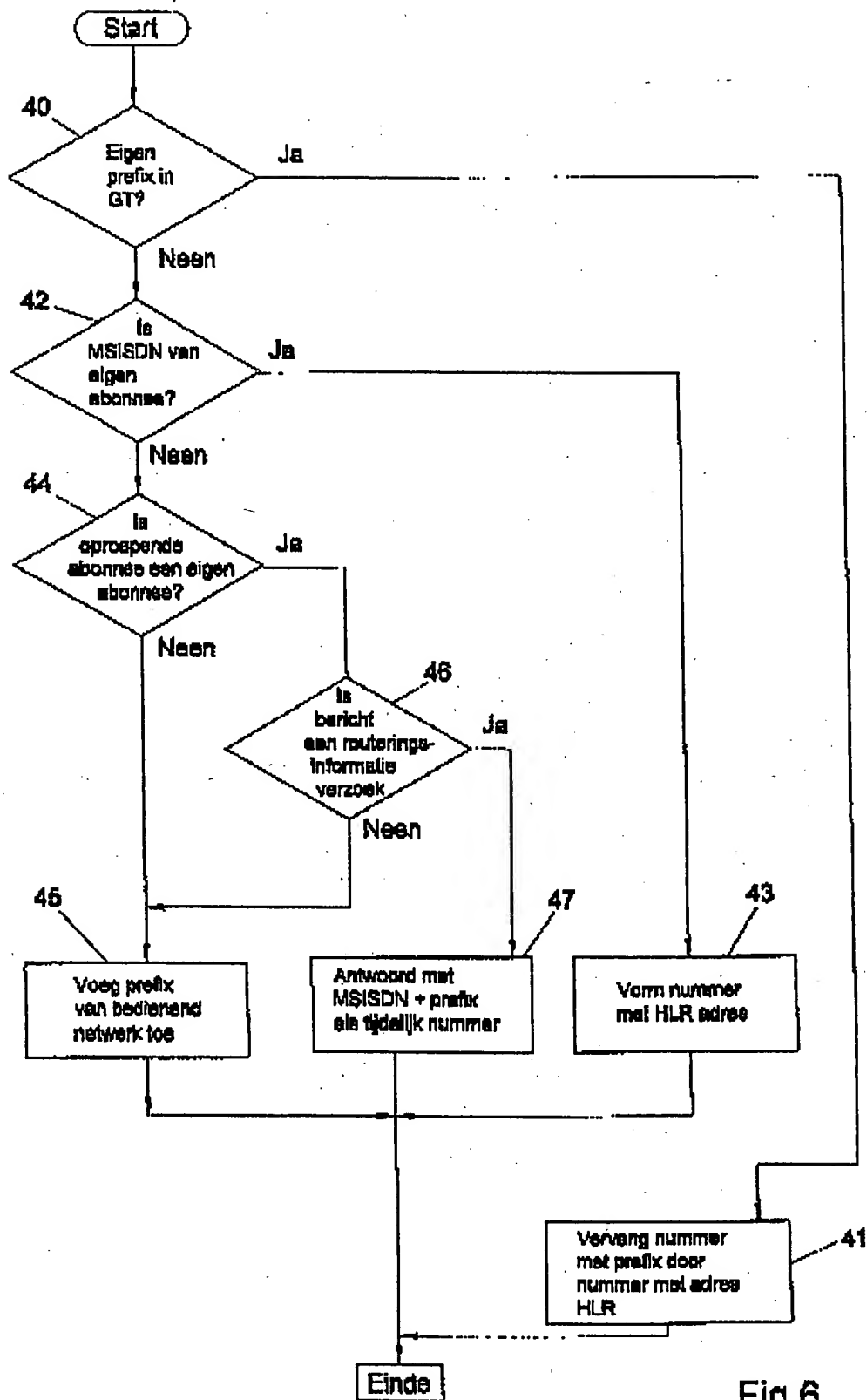


Fig.6



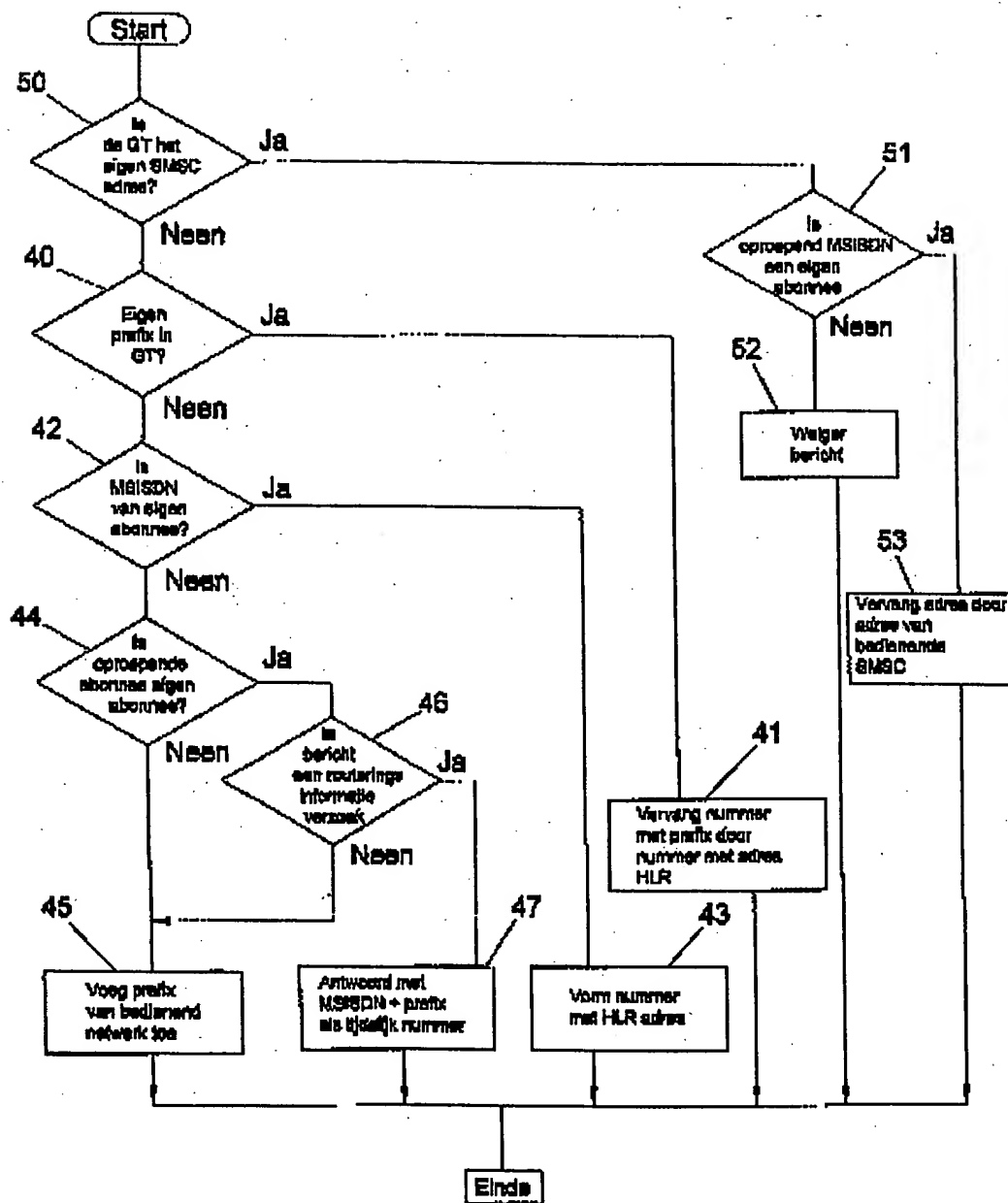


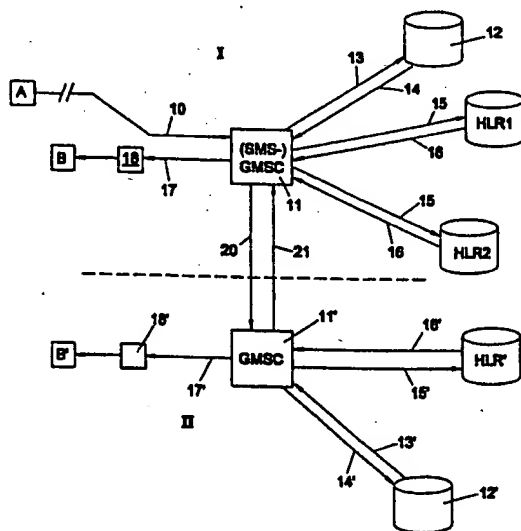
Fig. 7



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(54) Title: METHOD AND SYSTEM FOR PROCESSING CALLS



## (57) Abstract

A method for processing calls for communication equipment with a subscriber number ported from a first communication network (I) of a first operator to a second communication network (II) of a second operator, wherein in each communication network a database (HLR1, HLR2, HLR') of ported numbers is formed, which is accessible from at least one gateway exchange (GMSC), and in which the subscriber numbers ported from one operator to another operator are stored together with information about the network to which the subscriber numbers belong, and upon an incoming call (10) at the network for a particular subscriber number, the called subscriber number is compared with the subscriber numbers in the database and on the basis of the result of that comparison routing information for the further processing of the call is composed.

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BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

# INTERNATIONAL SEARCH REPORT

Intern. Patent Application No.

PCT/NL 98/00480

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 6 H04Q7/38 H04Q3/00 H04Q3/66		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 6 H04Q		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BISHOP T: "FREEING THE NETWORK FOR COMPETITION" TELECOMMUNICATIONS, vol. 29, no. 4, April 1995, page 75, 77-78, 80 XP002037911 see page 75, left-hand column, line 15-22 see page 76, left-hand column, line 6-20 see figure 1; table 1	1,7
X	EP 0 708 570 A (AT & T CORP.) 24 April 1996 see the whole document <div style="text-align: center; margin-top: 10px;">-/-</div>	1,7
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.</span> <span><input checked="" type="checkbox"/> Patent family members are listed in annex.</span> </div>		
* Special categories of cited documents :		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search  <div style="text-align: center;">25 March 1999</div>		Date of mailing of the international search report  <div style="text-align: center;">01/04/1999</div>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016		Authorized officer  <div style="text-align: center;">Gijssels, W</div>

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Intern. Appl. No.  
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	EP 0 854 656 A (SIEMENS AKTIENGESELLSCHAFT) 22 July 1998 see the whole document ---	1,7
X	WO 97 36451 A (ERICSSON, INC.) 2 October 1997 see the whole document ---	1-4,7,8
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